Bokaro Thermal power Station

Bokaro is the biggest power station in India. Pari of the capital coat of Bokaro Steam Power Station estimated at Rs 13.8 crores Law been met by a World Bank loan tumnting to 18.5 million dollars, or Rs 9 crores. Bokaro Station will obtain coal from a part of Berma seam, Kargalli colliery, which has been leased by DVC. This seam consists of low grade coal for which there is normally no market. Ash content is high, varying from 26 to 31 per cent. India’s deposits of high grade coal are limited and require to be conserved for iron and steel industry and Bokaro helps tills conservation.

Bokaro Station is connected to the DVC transmission network covering 375 miles of 132 kv line, 32 miles of 66 kv and 96 miles of 13 kv lines, serving an area of about 25,000 square miles.

As a result of a recent load survey of the DVC area total prospective maximum demand on DVC system was assedset at 282,000 kw, 459.000 kw and 550.000 kw during next live, ten and fifteen years.

Bokaro Steam Station order placed on international General Electric Company on February 23, 1949, ground broken at site December 29, 1949, Station opened on February 21, 1913.

BOKARO, unlike Tilaiya, does not constitute a first step in the scheme for taming the Damodar river. It does constitute, however, a milestone in the country’s progress. Situated on the river Konar just below where it meets the Bokaro river, the power station has been located close to the coal mine from which it gets its coal supply. Bokaro is 50 miles from Hazaribag and 233 miles from Calcutta by road. The power station has been designed for base load operation for about 37 weeks of the off-monsoon period and as a peak load station for the remaining 15 weeks in the monsoon. The later period of high load will provide an opportunity for general overhaul and inspection of machinery.

ORDER OF INCREASE

Designed for ultimate capacity of 200,000 kw, three units of 50,000 kw each have already been set up, of which the first goes into operation today and the other two will follow soon- by June next, according to present expectations.

Why a thermal station should conic first in a multi-purpose project which is primarily intended to control and utilise water power, one may naturally ask, though after the bitter experience of Bombay, even a layman will hardly need much persuasion to believe that a grid system depending exclusively on rain-fed rivers or lakes is not the best possible arrangement. Admitting the necessity for a thermal station for balanced supply and distribution of electricity through different seasons of the year, the priority that Bokaro enjoys and the fact that it happens to be completed first, still needs to be explained, though the result, in view of the existing demand for power in the valley, has been entirely peak load demand for electricity in the valley and the availability of power from hydro-electric installations. The mining belt, a major consumer, has its peak demand in monsoon for pumping out water from the mines just when the hydro-electric stations are in a position to give peak production. In the following seasons it is necessary to conserve water for purposes of irrigation and generation of electricity has necessarily to be stepped down and here the thermal station at Bokaro comes so very handy.

The boilers at the power station are designed to use inferior grade coal which is obtained by open cut mining of the Burmo seam at Kargali about 5 miles from the power station. The colliery belongs to Messrs Bokaro and Ramgarh Ltd and was under lease to the GIP railway. It has now been sub-leased to DVC for a period of 35 years. The mining will be mechanised and coal transported by aerial rope-way with a capacity of 150/200 tons per hour. The colliery is also connected to Bokaro power station by rail and road, to be utilised in the event of a breakdown of the rope-way. The leased area contains, it is estimated, about 17 million tons of coal, of which the following is an analysis:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>1.16 per cent</td>
</tr>
<tr>
<td>Volatile matter</td>
<td>20.2b</td>
</tr>
<tr>
<td>Fixed Carbon</td>
<td>53.15</td>
</tr>
<tr>
<td>Ash</td>
<td>26.6</td>
</tr>
<tr>
<td>Calorific Value</td>
<td>11,200 B T U</td>
</tr>
<tr>
<td>Fusion Point of</td>
<td>2/282 deg. F</td>
</tr>
</tbody>
</table>

The entire power station was designed by the International Gene-
February 21, 1953

with large size boilers, for which boilers also offer the added advan-
tages of generally higher efficiency; due to mote complete combustion
less ash residue, more rapid pick-
up or dropping of load, and better temperature control over wide load limits.

The selection of steam pressure and temperature for the boilers and turbines, higher than had previ-
ous practice, units are designed to ope-
rate normally on automatic control under constant as well as varying load conditions. The turbine gov-
erning system is actuated hydrau-
ically by oil pressure generated by a centrifugal pump on the turbine shaft. In general, other mecha-
nical control systems are operated by compressed air.

The combustion control system automatically distribute the effect of fluctuating requirements of steam by the turbine-alternator on the two boilers equally, controls the fuel iced of each boiler to main-
tain the desired steam pressure at any load, controls the furnace draft maintaining a negative pressure under normal operating conditions, controls the forced draft to main-
tain the fuel-air ratio, controls the pulverizer mill temperature so as to avoid fire hazards or inefficient grinding due to wet coal.

Other controls provide control of steam leaving the superheater, feed water, water levels in feed water heater and hot wells.

Main station controls are central-
ised and control boards are fitted with indicating and recording instruments, automatic and manual control devices, alarms and push-

OUTDOOR SWITCHGEAR

The use of forced-oil, water-
cooling for the 65,000 KVA main transformers resulted in lower cost, size and weight, and made possible transport over the railway from Calcutta. The 138-KV outdoor substation is remotely controlled from the duplex switchboard. A main and transfer bus arrangement is provided. The main bus is sec-
tionalised by disconnecting switches so that one section of bus can be removed from service for mainten-
ance and repair. A bus tie breaker is also provided so that any line [breaker may be taken out of ser-
vice for routine maintenance or repair. The disconnecting switches are motor operated and are inter-
locked with their respective breakers to ensure proper operation.

Altogether 11—138-K V, 1200 amp., 3500 MVA pneumatically operated outdoor type oil circuit breakers have been used. These are of General Electric Co. of USA manufacture as are all the transi-
formers, switchgear and control factors are of importance In


electricity Act 1910.

Licences granted under the
Indian Electricity Act are deemed to be revoked or modified to the
extent necessary for the purposes of the DVC Act and the Corporation is required to purchase the under-
taking concerned or to pay fair compensation, at the option of the
licences.

The Corporation is required to fix the schedule of charges for the supply of electrical energy, both bulk and retail supply. The Cor-
poration may also impose such con-
ditions as it may deem necessary or desirable to encourage the use of electrical energy.

大力发展热电联合的锅炉


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equipment both inside and outside the power station, relays and control, power cables, bus and ground equipment. Indoor switchgears are metal-enclosed of most modern design, completely factory assembled.

STATION SERVICE ELECTRICALS

Each generating unit is provided with a 3150-volt and a 400-volt station auxiliary bus. The 3150-volt bus derives its power directly from the generator through the 5000/6250 KVA, 132000/3150-volt transformer. The 400-volt bus in turn derives its power from the 3150-volt bus through the 1250-KVA, 3150/400-volt transformer. These two unit buses serve all the auxiliaries for their respective generator units.

In addition to the normal auxiliary supply there is a 5000/6250 KVA, 138000/3150-volt reserve transformer which is connected directly to a breaker on the 138-KV bus. This transformer is connected to the reserve 3150-volt bus. This reserve bus supplies power to the station essential auxiliaries such as coal handling, ash handling, lube pumps, etc. In addition this bus provides standby and starting-up power.

All the auxiliaries of this station are electrical.

STATION PROTECTION

A separate differential protective scheme, is used for the generator, main step-up transformers, and the 3150-volt station service transformers, ensuring high speed tripping and selectivity. The generator is protected by high speed product restraint differential relays. The 138-KV outdoor substation bus is protected by high speed differential relays which operate in from two to three cycles. Each 138-KV feeder is protected against phase-to-phase and three-phase faults by directional impedance relays, and against phase-to-ground faults by directional ground relays.

The control voltage for this station is 250 volt dc from lead cell acid storage battery with motor generator sets for charging, which battery also supplies power for emergency lighting.

The station has been provided with communication systems in two parts, loudspeaker and the plant telephone. Carrier Current telephone system is used for communication with outside the Bokaro Power House.

(Continued on page 18)
Damodar Valley

Panchet Hill Project

The last of the DVC dams on the Damodar is also primarily for flood control and the two together. In proportion of 2:1 to 3:1, with some help from the upper reservoirs. The discharge ends of the tunnels will be in the lower valley fully protected against the worst floods. The open cut works on the approaches and discharge ends is being done departmentally while the contract for the construction of the tunnel has been given to the Hindustan Construction Company. The tunnel is 18 miles, 4% miles high and 1140 ft long. All air compressors, rock drills and allied equipment used by Hindustan Construction as well as by the JVC on this and various other projects were supplied by Consolidated Pneumatic Tool Company, the British counterpart of the Chicago Pneumatic Tool of USA who have their Indian head office in Bombay.

Konar

The concrete-concrete earth dam which is being constructed on the Konar river, a tributary of the Damodar, consists of a concrete section across the bed of the river and earth dams in the banks. The dam is to be completed by June. The project was tendered by German firms and the contract for it has been given to a Bombay firm of engineers. Hindustan Constructions Ltd and Patel Engineering Co. Ltd. The improvement will be 200,000 acre ft. The main purpose of the dam is to supply cooling water to the thermal power station at Bokaro while the steam power plant at Bokaro which will need 400 cases for running the steam power plant. It has been located in order to take advantage of a steep gradient of 40 ft and an underground hydro-electric station of 40,000 kw will be installed here to utilise this gradient. The tail-race water will be discharged to the lower end of the river. Konar will also supply kharif irrigation for 36,000 acres and rabi to 68,000 acres.

Mathion

Mathion, on the Barakar river, the third of the first phase dams, is designed primarily for flood control. Scheduled for completion by 1954, it is being constructed fully departmentally. The dam will be a composite construction of concrete and partly earthen. It will have an underground generating station with an installed capacity of 900 kw and will provide irrigation for 370,000 acres in the lower valley.

DVC Grid

The DVC power transmission system, apart from transmitting its own hydro-electric and thermal power, has already taken up the surplus power of Sindri power stations and will consist of 380 miles of 132 kv double circuit main transmission lines with adequate substations and sub-transmission lines. The system will be capable of serving an area of 25,000 sq. miles. To enable Sindri power being made available in advance of the supply from the main grid, temporary works consisting of five 66 kv substations and 3 miles 66 kv lines were completed along with a portion of the permanent 132 kv of 33 kv main transmission lines. This section is now supplying power to:

- Chiranganj Locomotive Works
- Dishergarh Power Supply Co. Ltd
- Associated Power Co. Ltd
- Sijau (Jharkhand) Electric Supply Co. Ltd
- Indian Iron & Steel Co. Ltd
- Government of Bihar

Elsewhere will be found an estimate of the power requirements and supply, realized and potential, of the Damodar Valley area. The DVC grid will supply power to Jamshedpur, Ghatia, Kharagpur, Bardwan and eventually to Calcutta. Electric power to the Calcutta suburban railway is one of the projects which will be surveyed in the next financial year, the Rai Minister announced, while preparing the railway budget for this year. This itself does not mean anything for DVC but it may be an indication of the line of development.

The huge galvanized transmission towers required for the grid, weighing thousands of tons, have been supplied by Messrs. Alcock, down and Co. of Bombay. They have also supplied the pipes, a mast and other structures for the transmission system. The completion of the 132 kv grid transmission and distribution lines and installation work at grid substations have been carried out separately. Such a major heavy construction work had never been undertaken by any Government departments hitherto.
DURGAPUR BARRAGE

The last of the projects in the first phase is the barrage across the Damodar River which will receive water from the four storage dams for distribution over a million acres of irrigable land. The site is located at Durgapur in Burdwan district. Construction has begun on the irrigation-navigation canal which has a bed of 172 ft width in the upper reaches. About 15 miles of subsidiary canals which will be connecting the main canal has also been excavated. The barrage is expected to be completed by June 1955.

DVC FANS OUT

This is only a very brief outline of the major projects that will complete the first phase. Simultaneously with the constructional work the DVC has fanned out its activities in different directions the foremost of which are soil conservation and an intensive survey of the mineral resources of the valley which are rich and far from being fully exploited. Development of agriculture and fisheries in the valley, town planning, road building all these have been taken up. In fact, the logic of development is such that the last had naturally come first.

Now that the foundations have been laid, it is not only the remaining dams which will have to be taken up in the second phase—the complete project has provision for 8 dams in all, of which only 4 come in the first—the social and economic aspects of development must be given the next priority. For, the problem of development is not primarily one of engineering. The human aspect of the problem is the primary concern. It is being pin-pointed by the necessity of town planning and housing, to accommodate, in the first instance, the huge staff, and even more by the necessity of moving whole villages from the areas that have been or are going to be submersed by the dams.

It is not the problem only of moving people from one place to another. A village is something more than a collection of people who constitute it. A study of the village community, of the social organisation which provides a satisfying life to the people, is just as necessary for the success of the project as the solution of the technical problems of construction and power generation. For the rehabilitation of the valley, not only have new town-ships and villages to be set up, mineral resources and industries will have to be developed which will utilise the power, work will have to be provided for people in

**Damodar Valley Power Budget**

The total installed electrical generating capacity in the Damodar Valley area is now approximately 391,600 kw., excluding the Sindri Fertiliser Factory which has a plant of 80,000 kw. The installations consist of:

1. Small plants in 12 towns and villages 24,000
2. Industrial concerns 269,300
3. 39 power stations and 3 major licensees distributing power in the coalfields 98,300

Total 391,600

The aggregate maximum demand on the existing generating stations is 200,000 kw. But most of these sources of supply will be replaced by power from the DVC. The town installations except one are inadequate and uneconomical. The colliery power stations are likely to close down gradually. Power stations of licensees in the colliery area are inadequate for the load awaiting to be served and would be utilised to supplement bulk supplies from the DVC. The generating plants of most of the industrial users are incapable of coping with the increasing demand for power due to expansion of the industries. The aggregate total installed capacity of steam and oil engines used for purposes other than generation of electricity is estimated at 136,000 HP. These engines are old and are likely to be replaced by electric motors when electric supply becomes available.

The total prospective maximum demand on the DVC system had been assessed by the Central Technical Power Board very conservatively at 282,000 kw, 459,000 kw and 550,000 kw in the next five, ten and fifteen years respectively. The prospective maximum demand that can be catered for in the first stage of the DVC is only 198,500 kw, 281,600 kw and 332,700 kw at the end of five and ten and fifteen years respectively.

The initial power installations aggregating to 294,000 kw of installed capacity are made up as follows:

<table>
<thead>
<tr>
<th>kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bokaro thermal plant</td>
</tr>
<tr>
<td>Hydro-installations at Konar, Maithon and Panchet Hill</td>
</tr>
<tr>
<td>.. Tilaiya ..</td>
</tr>
</tbody>
</table>

Of these the first and the last will be fully in commission this year. The hydro installations at Maithon and Panchet Hill are likely to be ready by 1955-56. The Konar power station will be ready in the next year, 1956-57. In an estimate of prospective demand for power, the fact should not be lost sight of that the Damodar Valley is one of the most industrialised regions in the country, and contains 80 per cent of India’s coal, 94 per cent of her iron ore, 100 per cent copper, 70 per cent chromite, 70 per cent mica, 100 per cent kyanite, 45 per cent China clay and asbestos.

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